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THE PLANT DISEASE SURVEY

DIVISION OF MYCOLOGY AND DISEASE SURVEY

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RELATIVE IMPORTANCE OF WINTER INJURY AND SOME OTHER TROUBLES TO STRAWBERRY GROWERS IN NORTHERN STATES

Geo. M. Darrow and J. B. Demaree

In May and June the writers made an inspection of strawberry fields in eastern Maryland, Delaware, New Jersey, New York, Ontario, Ohio, Michigan, and Illinois to survey the damage due to winter injury and to other causes which are sometimes confused with winter injury, such as root rots and insects. State horticulturists, pathologists, nursery inspectors, and county agricultural agents kindly took us to the strawberry fields and helped in identification. Of course only a relatively small proportion of the total acreage was inspected, but since we asked specifically to see fields where injury, especially to roots, had been reported or found, we, at least, saw many of the troubles.

In eastern Maryland and Delaware, low temperatures on November 28 and December 1, 1936 had injured the crowns in many fields, particularly on the lighter, drier areas where the cold could penetrate deepest and most readily. Except for the most exposed spots, favorable spring weather (relatively cool and moist) had enabled the plants to recover and to produce good crops in spite of the injury. In low areas, as reported by Demaree and Darrow in this issue (page 394), the red-stele root-disease was sometimes serious. In one field the Cape Cod "dwarf" due to a bud nematode was found.

In New Jersey the senior writer found winter injury near Camden, but it had not caused serious losses. In one large field of the Catskill variety, the Cape Cod dwarf disease had affected possibly 5 percent of the plants, and the affected plants were barren.

In the fields visited in the Hudson River Valley of New York, yields were generally from 10 to possibly 30 percent of a crop. The loss from cold injury to crowns and roots was generally severe and more important than that due to other causes. Much of the injury occurred in the fall, but early spring injury may also have been even more serious. In one count, 74 percent, and in another, 95 percent of the prospective crop was destroyed, probably owing to early spring cold killing the fruit-buds and blossoms and to hail. Heaving had pulled plants out of the ground and caused severe losses even in fields with mulch between the rows. Mildew was severe on the Lupton variety. Cyclamen mite and root weevils had caused very severe losses (80 to 90 percent) in two fields. Bud weevils and crown borers had also done considerable damage. Some factor, possibly Botrytis sp., had caused 94 percent of dead or affected caps or hulls in two fields and severe losses in others.

In central New York and in the Oswego section, winter injury was evident and was probably more serious than that due to cyclamen mite and root weevil which were serious in some fields. The winter-injury damage showed

in crown injury and in plants heaved out of the ground. In one field, 50 percent damage to the Aberdeen and 10 percent to the Howard 17 (Premier) was observed. A trace of yellow plant (June yellows) in Chesapeake was seen.

In western New York, winter injury was severe and generally the worst trouble. Heaving was severe in small areas. "June yellows" was quite common in Howard 17 in this section. Dead caps or hulls were particularly serious in two fields of the Clermont variety, and only two caps not affected were seen. Since leaf spot (Mycosphaerella fragariae)was very severe, the dead caps were probably due to this disease. One field reported to have severe root rot was found to have a very severe infection of cyclamen mite.

Winter injury was severe in the St. Catharines, Ontario section and may be a major trouble there. One field mulched early in the fall showed no injury. Cyclamen mite and root weevils were serious pests in some fields. No red stele or other definite root-rot injury was seen.

In northern Ohio near Elyria, some winter injury and also some heaving were noted. In general, mulching was not done early enough. One field badly affected with cyclamen mite was seen.

In southwest Michigan near Bridgman, fields were so badly winter-injured that they were plowed up before harvest, and winter injury in that section was possibly the worst observed in any State. A little cyclamen-mite injury was observed.

In central Illinois only a trace of winter injury was seen. Red stele was observed in one field but in soil too wet for good strawberry land.

If the fields seen were representative of the region north of the Ohio and Potomac where over 90 millions of quarts of berries were produced in 1929, then for 1936-37 winter injury undoubtedly reduced the yield in this area by tens of millions of quarts, while in comparison, cyclamen mite and root weevil reduced the yield by tens of thousands, and except for Illinois and the eastern shore section of Maryland, Virginia, and Delaware, the red stele root disease reduced the yields by thousands of quarts only.

This survey trip was made to regions where root-rots have been reported for many years. In each section the request was made to see fields where root-rot, black root or other troubles had been reported. Except for the eastern shore section of Maryland and Virginia and in Illinois, there was no evidence that root diseases were troubles of general importance and even in those two sections they seemed to be of importance only on soil too wet for good strawberry soil. In contrast, winter injury of several types was present in most sections and was by far the most important trouble of the growers. At least in the fields seen in May and June 1937, black root, so-called root-rots, and dwarfing and dying of plants were mostly due to winter injury although sometimes to cyclamen mite, root weevil, and crown borer. It would seem that

until winter injury to crowns and roots is largely controlled by early mulching, it is not possible to evaluate the damage that may be due to other troubles. These observations, it should be emphasized, cover only one season. (Division of Fruit and Vegetable Crops and Diseases).

THE RED-STELE[1] ROOT DISEASE OF STRAWBERRIES IN THE NORTHEASTERN UNITED STATES

J. B. Demaree and G. M. Darrow

The first report[2] of the red-stele root disease of strawberries in the United States was made by H. W. Anderson in 1935. He stated that the disease was found in widely separated localities in Illinois and neighboring States. According to his observations, the affected plants usually appeared first in areas where the water-holding capacity of the soil was high, but later may spread to well-drained loam soil. Dr. Anderson called the disease "black stele", and further stated that it seemed to be similar to a destructive and widespread disease in Scotland known there as the Lanarkshire disease, Phytophthora disease, and red core.

About one-and-one-half years ago Mr. F. J. Anderson, then a graduate student in the University of Maryland, informed the writers that he had observed during the spring of 1936, near Federalsburg, in the Eastern Shore district of Maryland, a disease that he considered to be the same as the one reported from Illinois. His diagnosis was later verified by H. W. Anderson. During October, 1936, the senior writer accompanied Mr. F. J. Anderson on an inspection trip to the Eastern Shore of Maryland. The field near Federalsburg where the disease was seen in May was visited. No evidence of the trouble could be detected at that time, with the possible exception of stunted plants, which condition was prevalent throughout the Eastern Shore district that year, caused by a severe drouth extending from April to July.

During the first week in May 1937 a second trip was made with Mr. Anderson to the Eastern Shore district of Maryland. At this time an abundance of diseased plants was found, showing the typical discolored central cylinder of the larger fleshy roots. The farm near Federalsburg was first inspected. Many of the plants in a one-year-old strawberry field were wilting, others were stunted, with reddish small leaves on short petioles. The disease was not a serious factor in this field and was not uniformly distributed. In

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1/ The name red stele, in preference to black stele, is used in this paper as seeming more descriptive of the early symptoms of the disease.

2/ Anderson, H. W. Black stele root rot of strawberry. (Abstract). Phytopathology 25:5. 1935.

some sections of the matted rows 2 or 3 feet wide and up to 20 feet in length all plants were stunted. There were no circular areas indicating the spread of the disease from infected foci. The greatest number of diseased plants was found in two rows. One had been given an application of lime and the other an application of sodium nitrate. Whether the abundance of diseased plants in these two rows was a coincidence or was due to the treatment was speculative; at any rate, they presented a striking difference from the rest of the field.

While a number of fields were examined on different types of soil, only one other showed diseased plants. This was a small field of the two varieties, Blakemore and Lupton, near Pittsville, Maryland. The Blakemore plants were uniformly stunted and some were dying, and indications at that time pointed to an almost total loss of the crop. The variety Lupton was in a block of about 20 rows growing next to the Blakemore variety and appeared to be much more resistant. The plants were vigorous, with a good crop of green berries and blossoms. The only evidence of the disease found in the Lupton block was in short sections of each row for a distance of 25 or 30 feet, extending each way from a natural drainage depression running at right angles to the rows.

Later in May another small spot of diseased plants about 100 feet in diameter was found in a large field about 15 miles northeast of Pittsville. The diseased plants were in a low circular area with no means of surface drainage, which would naturally favor retention of water after rains. No other diseased plants were found in the field of about 20 acres.

The topography of the country in the vicinity of the diseased field near Pittsville and the one near Federalsburg is that of low, level, poorly drained land, necessitating the construction of drainage ditches through or around the fields to make them usable for cultivation.

An attempt was made to get some history of the disease. The grower near Pittsville reported that he had had some diseased plants in an adjoining field the previous year, but could not recall seeing the disease at any other time. The grower near Federalsburg had observed the disease regularly for the past 12 years, a greater loss occurring some years than others.

On May 17, 1937, Dr. J. S. Cooley brought to this laboratory some diseased strawberry plants showing typical red-stele symptoms collected from his garden near Beltsville, Maryland. The plants had grown on stiff clay-loam soil, but with good surface drainage. During the same week the disease was found on the U. S. Horticultural Field Station farm near Beltsville. Strawberries were grown on two fields on the Station farm. One small field situated on rolling gravelly soil showed no diseased plants then or at any other time during the season. The second field was on low level land, lying between two ridges. The soil is a stiff silt loam with poor under-drainage;

however, a small ditch which extends across the center of the field furnished fairly adequate surface drainage. The plants in this field consisted of a great number of varieties and selections used in strawberry breeding work. Each variety or selection was planted in a 50-foot strip, with 10 such strips in each row. The disease was present in about one-half of the varieties and selections, but did most damage to the selections that grew on each side of the ditch running at right angles to the rows. Different varieties and selections showed a wide range of susceptibility. Nearly all plants in a few of the 50-foot sections died during May and June. The plants in several sections, while they did not die, were injured and stunted so badly that they failed to set any fruit, while other selections showed no apparent injury and produced a normal crop of berries. In some cases the sections of normal plants were sandwiched between those having dead or badly diseased ones.

Since the red-stele disease was found to be damaging strawberries in a few small, restricted areas in Maryland, it was thought desirable to make a more extended survey of its prevalence in the northeastern United States. During June 1937 the writers visited some of the leading strawberry production centers in New Jersey, New York, Ontario, Michigan, Ohio, Illinois, and North Carolina. In this survey work we were assisted by pathologists, horticulturists, nursery inspectors, and county agents in each of the States and regions visited. These investigators were very helpful, as they were able to take us to strawberry fields where "root rot" troubles had been reported to them or to fields located on soil types where our observations would lead us to believe the disease could be found. Numerous fields totaling hundreds of acres were examined. The red-stele disease was found in five fields in four States. In New Jersey, strawberry fields were examined in several localities and a few diseased plants were found in a small planting between Matawan and New Brunswick. The owner of the field reported that about 20 rows of his field were set with plants purchased from a Delaware nursery; the balance of the field was set with home-grown plants. The field was on rolling soil with excellent surface drainage. The 20 rows of Delaware plants were set in a shallow dip with higher ground on each side. The plants in the 20 rows, as reported, became sick and stunted during early spring and were plowed under before fruiting, except the outside row, and the land planted to peppers. It was in this outside row that the diseased plants were found. Since diseased plants were not found in the larger section of the field which was set with home-grown plants, one would be led to suspect that the disease had been brought in from the nursery. However, the source of the diseased plants could not be traced.

In New York, strawberry fields were examined in the Hudson River Valley between Fishkill and Catskill, in Oswego County, and in the western part of the State, along Lake Erie. Two small centers of diseased plants were found. One was near Fishkill, on rolling, gravelly soil in a three-year-old field. Affected plants could not be found except in a small area not more than 100 feet in diameter. Diseased plants were scattered and hard to find, as winter

injury had also caused stunting of many of the plants. Diseased plants were also found in another field in New York along Lake Ontario, in Oswego County. Only a few stunted plants with roots showing the discolored central cylinder were seen. They were situated in a small area of wet, seepy soil at one corner of a sloping field. A considerable number of heaved and winter-injured plants occurred among those affected with red-stele.

In Ontario, fields were examined in the vicinity of St. Catharines and Vineland, but no red-stele affected plants were observed. Neither did we find any in Ohio, though a number of fields were examined near Avon, Lorain, and Elyria in a strawberry growing region west of Cleveland.

Two days were devoted to a survey of strawberry fields along the Lake Michigan shore in southwestern Michigan between South Haven and the Indiana State line. Numerous fields were examined in the heavy strawberry-producing region around St. Joseph, Bridgman, Broda, and Sawyer. One small planting was examined near Bridgman where one corner of the field dipped down in a low, level area with poor drainage facilities. All of the plants in this low corner were stunted, and bore small reddish leaves. The roots were black and many were decayed. Some of these plants still possessed healthy-appearing fleshy roots, but when the cortex was stripped off or when the roots were split with a knife, the exposed stele showed the red or reddish-brown color so symptomatic of the red-stele disease.

We expected to find the disease in Illinois, as it had been reported from that State previously. Our visit to Illinois was made on June 24 and 25, somewhat too late for a thorough examination, as the crop had been harvested, some fields burned over, and others plowed under. A few diseased plants were, however, found in poorly drained stiff soil (a seepy area of about one-fourth acre) at one edge of a field of about 30 acres near Vermillion.

In addition to the observations made by the writers this season on the prevalence of red stele of strawberries, Dr. H. H. Zimmerley, Director of the Virginia Truck Experiment Station, Norfolk, Virginia, reported by correspondence and orally to the writers that the disease was present in considerable abundance in 1937 in the peninsular or Eastern Shore district of Virginia (that portion of Virginia lying east of the Chesapeake Bay). This area is about 50 miles south of Pittsville, Maryland, and the two regions have similar soil and drainage conditions.

Discussion

The Phytophthora or red-core disease, as reported by Howells[3/], has proved a very serious menace to the culture of strawberries and has resulted in severe financial losses to growers in Scotland. The disease there is

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3/ Howells, D. V. The Phytophthora disease in the field. Scientif. Hort. 4:56-58. 1936.

evident first in the lower portions of the fields, but later spreads to other portions, irrespective of drainage or other environmental factors.

Formerly the strawberry crop in Lanarkshire was of considerable importance, but now it has dwindled to a skeleton of its former extent. Dr. Howells reports, "The disease has infected plants and caused destruction of crops on all types of soil under very different environmental conditions, in plantations of all ages, on new land, and on land which has been repeatedly used for strawberry culture."

Mrs. Alcock[4/] has made an extensive study of the disease and the causative organism as it occurs in Scotland. Her description of field symptoms of affected plants parallels those observed here, but some of her detailed descriptions do not tally so closely. She mentions that the infected fleshy or rat-taillike roots are black and that the cortex or outer tissues of the roots are soft and decayed; furthermore, she says, the fungus can be found in the sheath tissue around the central cylinder. This is contrary to our observations, as the affected fleshy roots are white and there is no evidence of the disease unless the cortex is slipped off or the root split with a knife; also, the fungus has not been found in the cortex. It is true, however, that these infected roots finally die and decay to the base. Mrs. Alcock also reports that the fungus, which she considers a Phytophthora, occasionally produces sporangia on newly attacked root tips and that sporangia can usually be induced to form by holding infected roots in water for a few hours. Many attempts have been made by Mrs. Alcock and others in Scotland to induce the fungus to grow on artificial media, but with negative results. We have not observed sporangia on infected roots, and have not been able to induce them to form by placing the roots in water and moist chambers. We have found very commonly a Pythiaceous fungus within the reddened stele of affected roots, with an abundance of large, thick-walled bodies, presumably oospores. The fungus has been readily cultured from the advancing point of the reddening stele where the discoloration has not extended to the base of the roots. The pathogenicity of the isolated fungus has not yet been tested.

Since there seems to be some difference as to symptoms (especially of those observed on the roots) of the disease and the fungus involved or associated here and in Scotland, there is some question whether the Phytophthora or red-core, and the red-stele or black-stele (as termed first in this country by H. W. Anderson)diseases are identical. It must be agreed that the disease here is of very minor importance at present, and for the most part has been found in plants growing in wet, poorly drained or seepy soils. We have seen the disease in only two fields where the drainage might possibly have been adequate (Matawan, New Jersey, and Fishkill, New York). In the

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4/ Alcock, Nora L. The Phytophthora disease of strawberries. Scientif. Hort. 4:52-56. 1936.

fields where the disease has been noted to be to any degree extensive and destructive (Beltsville, Pittsville, and Federalsburg, Maryland, and Bridgman, Michigan), there was no doubt that drainage was inadequate.

We have but meager information as to the history of the red-stele disease in this country. H. W. Anderson first observed it in Illinois in 1931; E. J. Anderson of Maryland saw it first in 1936. A grower near Federalsburg, Maryland, avers that he has had the trouble in his fields for at least 12 years. The disease apparently has not increased on his farm during that period. His loss of crop this year could be considered as slight to moderate. However, he reported that in some past years his loss was considerable. It appears that if the disease known as red stele of strawberries in this country is as virulent and as easily disseminated as the red-core or Phytophthora disease in Scotland, then we should expect a wider and more general and uniform distribution of this disease in the strawberry-growing districts of the Maryland-Delaware-Virginia peninsula, especially if it has been present there for at least 12 years.

Summary

The red-stele disease of strawberries was observed by the writers during the spring of 1937 in Maryland, New Jersey, New York, Michigan, and Illinois and was observed by Dr. H. H. Zimmerley near Norfolk, Virginia. The greatest abundance of diseased plants was found near Beltsville, Pittsville, and Federalsburg, Maryland, and at each of these three places the diseased fields were situated on low, wet soils not well suited for growing strawberries. Centers of infection in other States seem to be widely separated and in most cases, at least, confined to small, poorly drained, or seepy areas in larger fields. Throughout the regions visited the disease was of minor importance in strawberry production, being limited to an extremely small percent of the acreage planted to this crop. No signs were observed of the disease spreading from the affected patches to plants growing on higher and better-drained soils, and in only one instance (in New Jersey) was there any indication that the disease may have been imported from an infected region in nursery plants.

In some of the infested fields observed, there was ample evidence to indicate difference of susceptibility of varieties to this disease. This was clearly shown in the experimental strawberry plots used for breeding work on the U. S. Horticultural Field Station farm, Beltsville, Maryland, where in some cases selections growing in 50-foot sections of a row completely died between the stakes marking their limits, while the selection beyond the stake or those in adjacent rows grew vigorously and produced a good crop of berries.
(Division of Fruit and Vegetable Crops and Diseases).

LEAF VARIEGATION IN STRAWBERRIES NOT CONSIDERED A VIRUS DISEASE

J. B. Demaree and Geo. M. Darrow

A yellowing or leaf variegation, the exact cause of which is unknown, has recently become serious in certain strawberry varieties. Among important commercial varieties it is most serious in Blakemore, and it is apparently increasing in Howard 17 (Premier). While this trouble has been known for about 10 years on Howard 17 and a similar condition has been known for over 40 years on other varieties, the yellow-foliage plants of Blakemore have been observed only since about 1933. The development of the condition in Blakemore has been so rapid, however, that nearly all plantings known to the writers now show some yellow foliaged plants. In some cases from 25 to 50 percent, and in extreme cases all, of the plants are affected. The condition has been termed June yellows, leaf variegation, yellow leaf, gold-leaf, suspected mosaic, etc.

Where Strawberry Leaf Variegation is Prevalent and Varieties Affected

The disease is widely distributed and has been observed in the field by one or both writers in the Blakemore variety in Maryland, Virginia, Michigan, Massachusetts, Connecticut, New Jersey, Delaware, North Carolina, South Carolina, and New York; and has been reported also from Canada, Louisiana, Arkansas, Oklahoma, Texas, Tennessee, Missouri, and Illinois. It has been serious for many years in the Howard 17 in New England and has recently been reported as present in many plantings of the variety observed in the spring of 1934 in New York. Many varieties of strawberries raised commercially in 1935 have been found affected. Plakidas[1/] reported the Beaver, Eaton, and Glen Mary in Wisconsin, the Howard 17 (Premier) in Massachusetts, Maine, and New York, the Mastodon in New York, the Peerless in Massachusetts, the Superb in New Jersey, the Van Dyke in Ontario and New Jersey, and the Wyona in New Jersey as being affected. Darrow[2/] has also reported the disease in Kellogg Prize, Big Late, and several everbearing varieties, as well as in many seedlings and selections in his breeding work. June yellows has been found in all the principal wild species of strawberries. In breeding work, seedlings may show yellow cotyledons as soon as they appear above ground, or the yellowing or variegation may not show until the seedlings have one, two, or several leaves, or until the plant has been set in the field. Variegation or yellowing may not show until the seedling has been selected as a promising new variety has been propagated, or has been sent out for trial. No records of June yellows or variegation in a few of the leading varieties, including Klondike, Missionary, Dorsett, Dunlap, Parsons Beauty (Gibson), Aroma, and Marshall, have come to our attention.

1/ Plakidas, A. G. The June yellows of strawberries. Phytopathology 22:22. 1932.

2/ Darrow, G. M. Notes on variegated leaf troubles of strawberries. Plant Dis. Reptr. 18:26-29. 1934.

Description

The most prominent and characteristic sign of the disease is yellowing and variegation of the leaves, the exact appearance of which varies with the variety, season, and region. Early stages of the disease may show as a faint streaking and mottling of the new leaves with yellow or cream and green. Later the leaves lose more and more of their green color and finally become golden- or light-yellow or cream color. Badly affected plants become stunted and unproductive, depending on how far the yellowing has progressed. Affected plants have never been known to recover, but may live for two or three years, becoming more stunted and yellow each season, and finally dying. Variegated mother plants produce only variegated runner plants. The disease is more conspicuous during early spring and early summer than at any other period of the year. Each variety has a characteristic yellow-and-green pattern, some being chiefly mottled, others chiefly streaked. In some varieties the colors are nearly white and green.

Several investigators have studied the behavior of strawberry variegation in both the genetic and virus aspects. The negative attempts of Berkeley[3/], Guba[4/], and Plakidas[5/], and the writers to transmit the disease artificially with insects, sap transfers, grafting of diseased and healthy runners and roots, and other methods of technic commonly employed for transmitting virus diseases, present rather conclusive evidence of the noninfective nature of the disease. On the other hand, evidence supporting the genetic-origin postulation has become more convincing as the result of careful breeding work.

Field evidence of the spread of the disease from affected to healthy plants is also lacking. The disease does spread along the rows by runner plants, especially where the plants are grown in matted rows. In old fields, 3 or 4 years after setting, it is not infrequent to find sections of a row of 10 to 15 feet or more where all or nearly all the plants are yellow, stunted, and unproductive. As stated above, plants affected with June yellows produce only diseased runner plants, and apparently this is the reason that all plants in restricted sections of rows are affected. The evidence from the breeding work suggests that the yellowing results from a sporting or mutation and that it is a genetic weakness of the varieties affected and is not due to a virus. June yellows should not be confused with yellowing due to alkali in many western regions, or to manganese and copper deficiency in some of the Coastal Plain soils, or to the definitely determined virus disease xanthosis.

3/ Berkeley, G. H. Strawberry mosaic. Rept. Dom. Bot. Canada 1927: 128-130. 1928.

4/ Guba, E. F. "Suspected mosaic" of the strawberry. Phytopathology 23:654-661. 1933.

5/ Plakidas, A. G. Op. cit. footnote 1.

There seems to be evidence that yellows or variegation shows up only in certain stocks of the Howard 17 (Premier) and that substitution of stocks in which the yellowing has not occurred is a fully satisfactory control practice. During the past two or three years a few stocks of the Blakemore variety have been found that have remained relatively free of yellows over a period of 8 or 10 years. Millar[6/] reports finding a stock of Blakemore in Arkansas whose source was traced to a lot of 50 plants purchased in the East about 1929. In 1935 5 fields were found within a radius of 3 miles, progeny of the original 50 plants, that were yellows-free. In addition, another small field of one-half acre with no yellow plants was found in the same county. In 1936 60 new fields were set with plants from the 6 yellows-free fields, or a total of about 70 acres. At the end of the season 14 of the new fields were yellows-free, 43 fields had less than 1 percent yellow plants, and 3 fields between 1 and 2 percent.

In 1928 a few Blakemore plants were sent to the U. S. Pecan Station near Albany, Georgia, and all plants have continued to be green through the years since. In 1936, stock from Albany, Georgia, was sent to Beltsville, Maryland, and a 350-plant row remained green throughout 1936 and 1937, though now (October 20, 1937) two clones appear to be yellowing. In addition, several thousand plants were propagated from the row at Beltsville in 1936 and sent to nurseries, and additional stocks sent out from Albany, Georgia. Although not all plantings have been surveyed, many have been, and 9 yellowing clones out of some 3,000 in Maryland and Delaware were found. In Illinois 15 plants in 600, and in Virginia 15 plants in 1,000 have started yellowing. In contrast, in the row adjacent to that of the plants from Albany set with unselected stock, 88 of the 100 clones of Blakemore have already turned yellow. The rate of appearance of the yellowing in this Albany stock so far is not sufficient to be a serious field problem. Besides the Arkansas and Albany stock, other stocks have been reported as free from yellowing.

The appearance of sports has been considered in most instances as the appearance of a recessive character in somatic tissue. If variegation or yellowing is of this nature, then by selfing it would seem that a proportion of yellow seedlings might appear. This has been found to be the case with some varieties at least. For example, 14 of 59 selfed Blakemore plants turned yellow in 1936 and 1937 at Willard, North Carolina, after being set in the field. Other records of selfed varieties are as follows:

	Yellow	Normal	Period in Field	Location
U.S.2320 (Blakemore x Fairfax) selfed	1	31	1 year	Willard, N. C.
U.S.2320 (Blakemore x Fairfax) selfed	0	42	2 years	Beltsville, Md.
U.S.1914 (" x Ettersburg 450) selfed	2	132	2 "	"
U.S.1557 (Howard 17 x Redheart) selfed	0	58	2 "	"

6/ Millar, P. H. Freedom from "yellows" of certain plantings of the Blakemore strawberry. Plant Dis. Reptr. 21:70-71. 1937.

	Yellow	Normal	Period in Field	Location
U.S.2115 (Chesapeake x Fairfax) selfed	0	22	2 years	Beltsville, Md.
U.S.1128 (Howard 17 x Ettersburg 450)selfed	1	2	2 "	"
U.S.2120 (Chesapeake x Fairfax) selfed	0	18	2 "	"
U.S.1445 (Blakemore x Howard 17) selfed	8	18	2 "	"
Blakemore selfed	30	49	2 "	"
Fairfax selfed	0	30	2 "	"
U.S.2102 (Ettersburg 904 x Fairfax) selfed	1	13	2 "	"
U.S.2108 (" " x ") "	0	34	2 "	"
Southland selfed	0	12	2 "	"
N.C.302 (Blakemore x Fairfax) selfed	0	38	2 "	"
U.S.1425 (Howard 17 x Redheart) selfed	0	14	2 "	"
Dorsett	0	2,000	1 year	"

It would seem that selfing to test for yellowing in the genetic stock might prove useful to breeders and possibly, if records on large enough numbers of selfed seedlings are obtained, may be used to predict the appearance of yellow sports in any variety.

Evidence so far indicates that yellowing is not due to a single gene. Even if by selfing no yellow plants appear, this is by no means final evidence that a complementary gene for yellowing may not be in the variety. Thus, Dorsett selfed has given no yellow seedlings, but when Blakemore and Dorsett were crossed, 43 out of 377 seedlings, or 11 percent, turned yellow in the field. In addition, 6 of the 26 numbered selections of this cross have since turned yellow. Eight (3 percent) out of 252 crosses between Southland and Blakemore turned yellow in the field, but none of the selections in the two years since have turned. None of the 123 seedlings of the cross Blakemore x Fairfax turned yellow in the field.

Very considerable progress is being made in understanding and in handling the trouble. Location and propagation of stocks of Blakemore, Howard 17, and other varieties, which do not turn yellow, or which turn yellow slowly as compared with ordinary stocks, is an immediately practical method of control. The use of varieties in which the genes for yellowing are not found and an understanding of the method of inheritance seem to be possible methods for origination of non-yellowing varieties by breeders. (Division of Fruit and Vegetable Crops and Diseases).

VERTICILLIUM WILT OF PEPPER

B. A. Rudolph and W. C. Snyder

While surveying the extent of loss in Southern California due to the spotted wilt virus on pepper, Capsicum annum[1/], C. F. Scott and M. W. Gardner encountered a serious disease of fungus origin. Specimens, collected August 16 from the Talbert area in Orange County, were sent to the writers for diagnosis. Tissue platings were made on an agar medium from the discolored vascular systems of two sets of diseased pepper plants, one from a field of the variety, Anaheim Chili, and the other from a planting of Mexican Chili. In the case of every plant cultured, Verticillium appeared consistently and to the exclusion of other fungi. The fungus appears to agree with V. albo-atrum. The fact that the fungus was readily obtained from each of a number of diseased plants is considered to be strong evidence that the disease is a verticilliosis.

Field symptoms consisted in the dropping of lower leaves, and the burning or browning of the edges and tips of leaves still on the plant. In cutting away the healthy cortex, a pronounced browning of vascular cylinder was exposed. This vascular discoloration extended into the green stem and branches some distance above ground. Although a conspicuous yellowing was lacking, the symptoms might pass for a Fusarium wilt. However, in no case was Fusarium isolated from the discolored internal tissues.

The field of Mexican Chili peppers was in its fifth year of peppers and showed an estimated loss of 20 percent due to verticilliosis. It was observed by Gardner and Scott that most of the damage was limited to one part of the field. On being questioned, the grower recalled that he had made a replanting of that part of the field three years ago with plants obtained from a grower who had the disease on his land.

The field of Anaheim Chili peppers showed only 1 percent loss due to the disease. However this field was only in the second consecutive year for peppers.

It seems that Verticillium may account for a considerable amount of the pepper failure ascribed to other causes each year in Southern California.

An examination of the literature indicates no authentic report of Verticillium wilt of pepper in this country, although it is known to occur in Europe. (California Agricultural Experiment Station).

1/ The specific name C. annum is spelt with one "u" following the lead of certain European writers. Bailey, however, spells it annuum.

ILLINOIS 1937 VEGETABLE CROP LOSSES FROM DISEASE

K. J. Kadow

Everything considered, the 1937 growing season in Illinois was very favorable, and high quality vegetables were produced very generally. For the most part, the increases in yield more than offset the losses from plant diseases.

TOMATOES: Soon after tomatoes were set in the field, early blight (Alternaria solani) began to appear and in some areas caused rather serious defoliation and subsequently reduced quality and yield of fruit. In many cases the collar-rot phase of the disease was of definite commercial concern, causing the death of nearly 30 percent of field transplants. The disease was most serious in southern-grown plants, although several exceptions to this generality existed. Certification of seed and plants did not seem to materially alter the prevalence of the disease, which seemed to be directly correlated with the excessively wet weather in early June. The disease was also found on peppers, but did not seem to be of much concern on this crop.

Septoria leaf spot (S. lycopersici) was very spotted in the State. In some areas plants were completely defoliated as early as September 1, but for the most part losses were light.

Some bacterial canker (Aplanobacter michiganense) was found in nearly every field examined. In only a few instances, however, was it of any great concern. The disease was much less prevalent in plantings where only certified seed and plants were used.

Bacterial spot (Bacterium vesicatorium) was generally the cause of fruit infections to both tomatoes and peppers, and on peppers it caused a great deal of leaf spotting, but the losses with few exceptions were not great.

Fusarium wilt (F. lycopersici) caused the usual losses, being of most concern to market and home gardeners who persist in growing susceptible varieties. As a rule, commercial losses were small.

The virus diseases of tomatoes were not as troublesome this year as is usually the case. A little spotted wilt was found as was also cucumber mosaic on tomatoes. Unidentified mosaics were prevalent but not damaging.

CRUCIFERS: Club root (Plasmodiophora brassicae) was very serious this year in all plantings of susceptible crucifers on contaminated soil. In a few such instances the losses of cabbage and cauliflower were as much as 60 percent; however, the general average for the State was estimated to be between 5 and 10 percent.

Cabbage yellows (Fusarium conglutinans) was also generally important when susceptible crucifer crops were grown on infested soil. Market gardeners suffered greatest losses since they insist upon growing susceptible varieties.

Crucifer mosaic was very evident in many plantings of cabbage, but the losses from it did not seem to be important.

White rust (Albugo candida) was the most troublesome disease of horse-radish, although losses this year were less than 5 percent. Ordinarily it is much more serious in Illinois.

BEANS: Both bacterial blight (Bacterium phaseoli) and anthracnose (Colletotrichum lindemuthianum) were present in isolated plantings where they usually caused heavy losses. The damage in the State as a whole was not great.

PEAS: Mosaic of peas was very serious this year in a few plantings. The losses for the State as a whole did not appear to be important.

CARROTS: Leaf blight caused principally by Macrosporium carotae was serious in many early plantings, resulting in sizeable reductions in yield. However, the average losses were not great.

ONION: Onion smut (Urocystis cepulae) was very bad this year, except where the seed had been drilled several hours before heavy rains fell. It seems that rains fell soon after several large growers drilled their seed and diluted the formaldehyde so as to reduce its effectiveness. Losses in Cook County were estimated at about 10 percent. Many small growers never attempt to control the disease and their plantings this year were nearly total losses.

GENERAL: Leaf spot diseases, caused by species of Septoria, Cercospora, Macrosporium, Alternaria, etc., were generally in evidence on crops susceptible to them, although losses were seldom important. This is also true of bacterial leaf spots of vegetables.

Losses from damping-off (principally Pythium and Rhizoctonia) in plantings of susceptible crops, such as spinach, beets, cucurbits, and peas, and also seed rotting, were very severe in late May and early June plantings. In several instances as few as 15 percent of the seed planted produced healthy seedlings. Where proper seed treatments were applied, the disease was of no commercial concern. Unfortunately, few growers treated their seed. (University of Illinois, Department of Horticulture).

LOSSES FROM SMUTTY WHEAT IN THE PACIFIC NORTHWEST, 1930 TO 1937, AS SHOWN BY TERMINAL INSPECTION OF CAR RECEIPTS 1/

Bert W. Whitlock

For a number of years we have used the inspections made in the month of August as an index to the quality and condition of the new wheat crop. The evidence secured during August has in the past checked closely with the annual out-turns, and so we feel that the figures secured during August 1937 may safely be used as a basis for some comments on the smut situation in the Pacific Northwest.

For several years we have noticed a decline both in the degree of smut and in the percent grading smutty. This decline undoubtedly is due to the introduction of smut-resistant varieties and to more thorough methods of seed treatment. Occasionally heavy winter killing and reseeding to spring wheat has been a factor in the reduction in percentage of smutty wheat receipts, but winter killing cannot be given much credit for the very definite trend toward less smut observed during recent years.

In 1935 the smut infection had dropped to 23.4 percent from the high figures of 36.6 percent in 1931. In 1936 it had dropped to 16.7 percent and the August 1937 figures show the remarkably low figures of 7.9 percent smutty.

Table 15. Percentage or the number of cars of wheat grading smutty in the car receipts at Columbia River and Puget Sound terminal inspection points and Spokane for the years 1930 to 1936 and for the month of August for the same years.

Year	For total yr.	For Aug.
	Percent	Percent
1930	28.6	26.9
1931	36.6	40.5
1932	23.0	27.0
1933	22.0	24.2
1934	20.0	22.2
1935	23.4	23.4
1936	16.7	19.2
1937	7.3*	7.9
Mean	22.2	23.9

* On the basis of the averages the 1937 percentage of smut might be predicted at 7.3.

1/ From Extension Pathologist, Serial No. 29, pages 33-35. Oct. 1937.

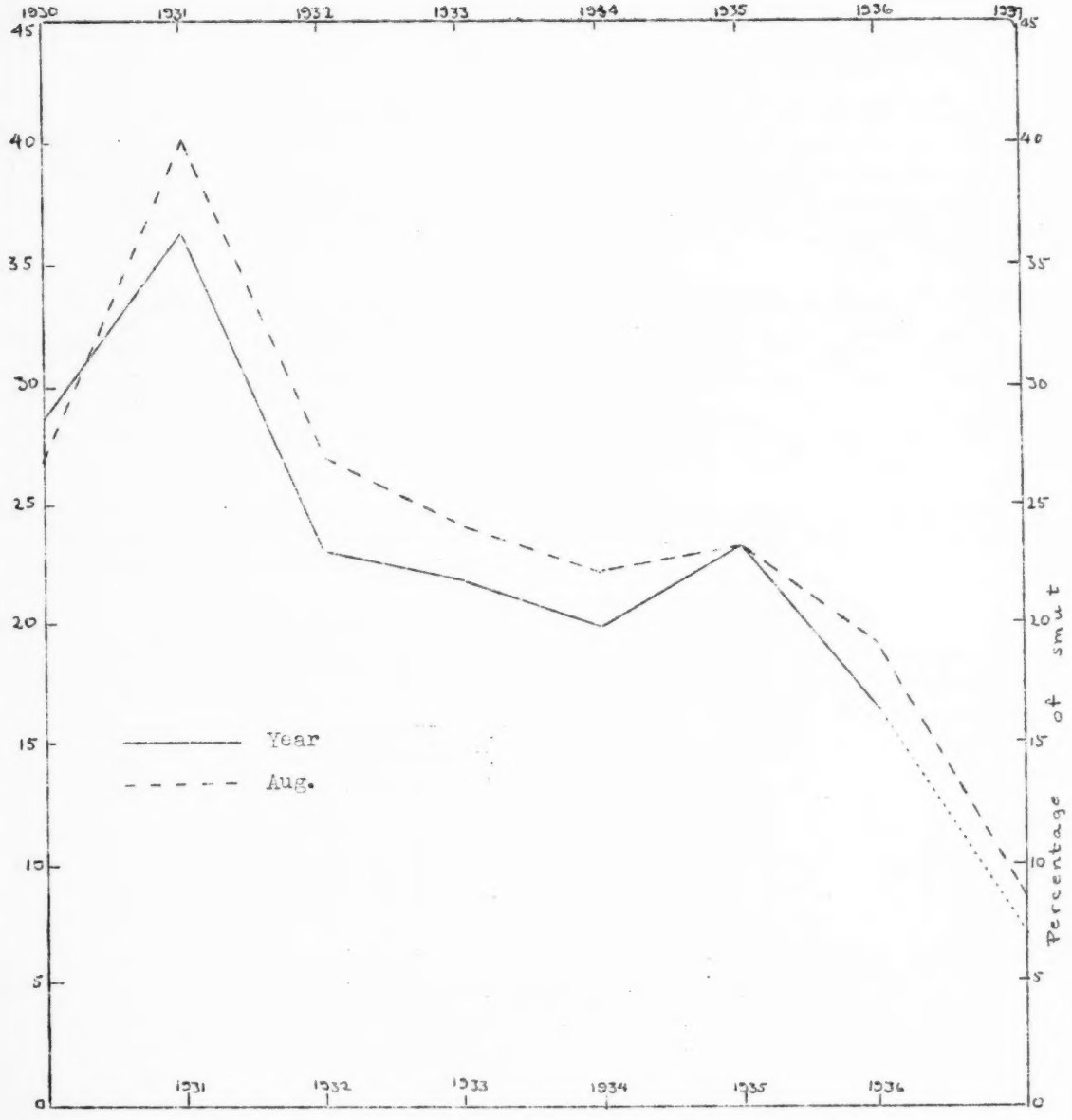

Fig. 58. Percentage of the number of cars of wheat grading smutty in the car receipts at Columbia River and Puget Sound terminal inspection points and Spokane for the years 1930 to 1936 and for the month of August for the same years.

Figure 58 and table 15 show this trend in detail for the years 1931 to date. (Federal Grain Supervision, Pacific Coast Headquarters Office, Portland, Oregon).

A CORRECTION

Through an obvious error (editorial, not Dr. Boyd's) potato blackleg was attributed to Phoma lingam instead of to Bacillus phytophthorus on page 281 of the preceding issue.